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ABSTRACT

The question of tenure as an economic variable is discussed. Using data from the 1973 ACE Survey of Teaching Faculty, a statistical model is provided to estimate time from Ph. D. to tenure. Results show that the tenure rate (the chance that a nontenured faculty member will be granted tenure in any given year) did increase during the period of rapid growth in academia from 1960 to 1968 in all types of institutions and in all fields within these institutions. After 1968, the tenure rate continued to increase in public institutions, but more slowly. However, in private institutions, the tenure rate remained constant or declined between 1968 and 1972. It is concluded that tenure rate did behave as an economic variable in the sense that higher tenure rates occurred at the same time as the rapid increase in employment in academia. The appendices contain a two-way logit model for the estimation of age and date effects, and complete tabulation of results. (SPG)

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Market Conditions and Tenure in U.S. Higher Education 1955-1973

A Report for the Carnegie Council on Policy Studies in Higher Education

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Project on Quantitative Policy Analysis Models of Demand and Supply in Higher Education

Technical Report No. 2

July, 1977

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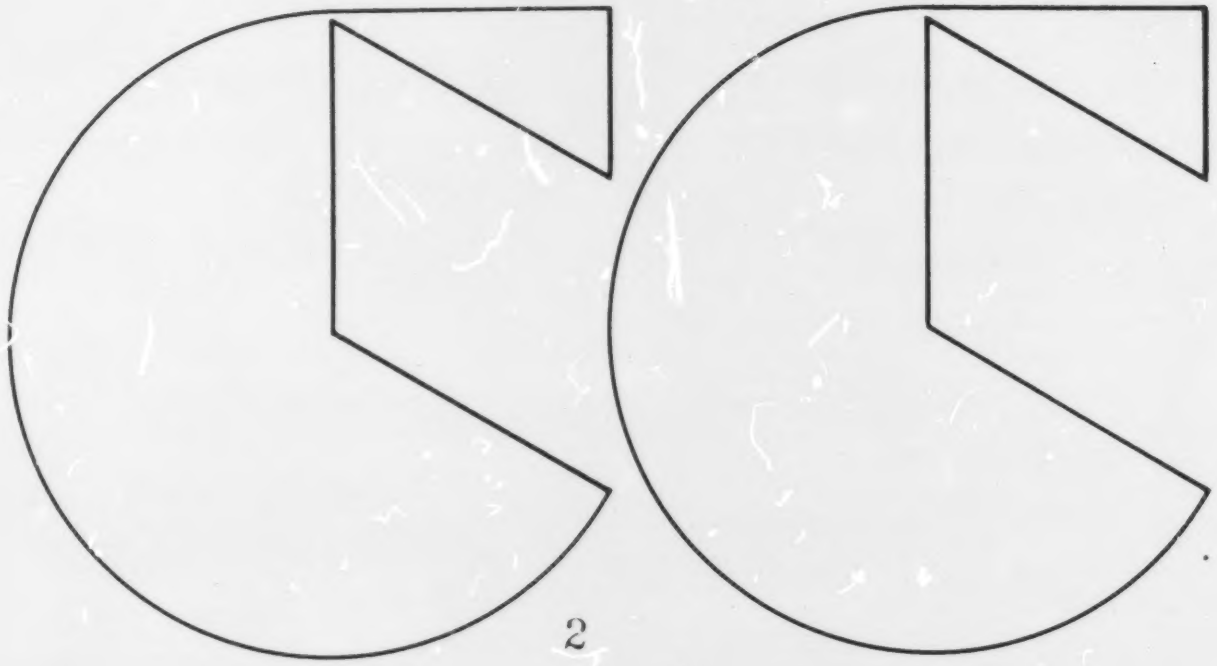

MARKET CONDITIONS AND TENURE IN U.S. HIGHER EDUCATION: 1955-1973

Technical Report No. 2

July, 1977

Carnegie Council on Policy Studies
in Higher Education

Project on Quantitative Policy Analysis Models
of Demand and Supply in Higher Education

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Contents

1. Introduction and Summary 1

2. Data 5

3. A Statistical Model. 8

4. Results. 10

5. Some Qualifications. 21

6. Conclusions. 23

7. References 25

Appendix 1. A Two-Way Logit Model for the Estimation of Age and Date Effects. 26

Appendix 2. Complete Tabulation of Results. 40

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Market Conditions and Tenure in U.S. Higher Education:
1955-1973

1. Introduction and Summary

The argument most frequently given for the existence and extension of tenure is that of academic freedom. Yet, as Fritz Machlup (4) described so clearly in his 1964 AAUP Presidential Address, tenure has economic as well as political implications for both faculty members and the institutions of higher education in which they work. It is the question of tenure as an economic variable that will be addressed in this paper. We feel that considerations of academic freedom alone are sufficient to justify its continued existence. The question addressed here is how, as an economic variable, tenure has changed as conditions in the academic labor market have changed and how it may change in the future as the academic labor market enters a period of what may, at best, be called the "steady state." The results presented in this paper show that tenure has indeed behaved as an economic variable. As enrollments began increasing at increasing rates in the early 1960's, not only did faculty size increase, but median time from receipt of Ph.D. to promotion to tenure fell rapidly until the late 1960's, when it became constant or increased for most types of institutions.

Tenure is, however, but one aspect of adjustment in academic labor markets. Salaries, workloads, attrition, retirement, and the age structure of faculty are other aspects of adjustment that would have to be considered in a complete model of the academic labor market. An even broader model would include the more fundamental sources of supply and demand for academic labor: enrollments and non-academic demand.

In this paper we shall look at tenure as one aspect of adjustment in a market where faculty/student ratios and salaries adjust slowly and are

constrained to be more or less equal within ranks and across fields.[1] From the point of view of the faculty member, tenure provides security of employment. If alternative occupations carry with them some non-zero chance of unemployment, a tenured job in academia will be more attractive because of its security of employment than a non-tenured job that in all other respects offers similar characteristics. Clearly, if a tenured job also means a promotion in rank and salary, lifetime income will also be higher the earlier an individual is promoted to tenure. In the presence of constraints on salaries, tenure can act as a "compensating differential" that enables academic employers to compete for qualified persons even though they pay lower salaries than non-academic employers. Within academia, differences in chances of obtaining tenure may be a way in which those fields in which there is the greatest growth or greatest non-academic competition can compete even though salaries are constrained to be equal across fields and within ranks. If academic employers provide tenure while non-academic employers do not, we would expect academic salaries to be lower than non-academic salaries because academic employment will be more certain. Other things equal, we would also expect higher tenure ratios in fields in which there is greater non-academic demand.

Although tenure may be used as a competitive weapon, it is a two-edged sword. From the point of view of the academic employer, tenure acts as a constraint on labor force adjustment in the face of changing enrollment demand. In particular, when enrollment becomes stable it limits the institution to two main sources of attrition, which can create places for new hires:

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[1] We exclude professional schools from this study.

retirement and non-renewal of contracts for non-tenured faculty. The higher the proportion of tenured faculty, the relatively greater will be the dependence on retirement as a source of slots. The institution will be a victim of having successfully used tenure as a competitive weapon in the past. In particular, the younger the tenured faculty, the smaller will be retirements as a proportion of the faculty and the less flexibility will the institution have. When enrollments are growing, this apparent loss of flexibility is less, since the faculty can grow as well, and a high rate of new hiring can provide that growth.

Tenure also has implications for the age structure of the faculty. The younger are those that are given tenure during a period of growth or shortage of particular types of faculty, the longer is the tenure commitment of the institution. The result of failure to plan for a decline in demand following a period of growth is a lengthy commitment to a young but aging faculty. It is commonly assumed in academic circles that there is a relation between the age of a faculty member and ability to produce instruction and research. Thus, changes in the age structure of the academic labor force resulting from past tenure practices may have implications for the quantity and quality of the output of higher education as a whole.

The statistical model that is described below estimates the tenure rate, which we define as the chance that a nontenured faculty member will be granted tenure in any given year. The tenure rate is dependent upon conditions specific to that year and on the time that has elapsed since the faculty member obtained the Ph.D. degree. Time since the Ph.D. (which we often refer to as "age") is presumably correlated with the accumulation of those things upon which the decision to grant tenure is based: publications,

teaching experience, reputation, etc. It also reflects the institutional fact of the guideline effect of the 1940 AAUP Statement on Academic Tenure, although surveys of tenure practices have shown that few institutions adhere to all the guidelines in the 1940 Statement [(2) pp. 220-225] . This age effect, however, is modified by market conditions for which the date effect is a proxy. For example, simply by virtue of being non-tenured and available in the expanding academic market of the early 1960's, we would think that a faculty member would have a greater chance of being given tenure than if he had been non-tenured in the early 1950's, at the same age. In future research, we hope to explain these date effects by observable changes in enrollments and, possibly, salaries. We should then be able to predict how tenure will adjust in the future.

To briefly summarize the most important result: we find that the tenure rate did indeed increase during the period of rapid growth in academia from 1960 to 1968 in all types of institution and in all fields within these institutions. After 1968, the tenure rate continued to increase in public institutions, but more slowly. However, in private institutions, the tenure rate remained constant or declined between 1968 and 1972. Thus it would appear that tenure rate did, indeed, behave as an economic variable in the sense that higher tenure rates occurred at the same time as the rapid increase in employment in academia. In private institutions, which were relatively harder hit by the declining rate of increase in enrollments in the late 1960's, we see quite rapid downward adjustment of tenure rates at the same time.[2] Let us now look more closely at the model and the data.

2. Data

The estimation that is reported below uses as data information from the 1973 ACE Survey of Teaching Faculty (1). In this survey, faculty members were asked the date at which they obtained their highest degree and the date at which they first became tenured, if they were tenured. We limited our sample to Ph.D.'s with full-time teaching positions and estimated age and date effects for four types of institutions of higher education. The distribution in the sample by type of institution in the 1973 survey is shown below in Table 1.

Table 1

Distribution of the ACE Sample
By Type and Control of Institution

	Control	
Type	Public	Private
University	14290	4764
4 Year College	1972	3071

[2] We have estimated the same model using data from the 1975 Survey of Teaching Faculty sponsored by the Carnegie Council on Policy Studies in Higher Education. Qualitatively the results are the same as those reported here. The 1975 sample is about one-quarter the size of the 1973 sample, however, which makes the estimates more variable. For expository reasons, we present results from the 1973 survey. A report on results from the 1975 survey is available from the author.

The proportion of those who were non-tenured in the previous year who were granted tenure, for each year since receipt of highest degree and for each date since 1947 are presented in Tables 2a and 2b, respectively. These raw tenure rates taken alone, however, do not allow us to isolate market effects from the effects of changing age structure on the chances of promotion to tenure. For example, very young faculty will, typically,

Table 2a

RAW AGE-RELATED PROMOTION RATES
1973 SURVEY

AGE	*PUBLIC UNIVERSITY*	*PRIVATE UNIVERSITY*	*PUBLIC COLLEGE*	*PRIVATE COLLEGE*
1	0.022	0.014	0.037	0.028
2	0.043	0.020	0.063	0.035
3	0.092	0.050	0.116	0.054
4	0.121	0.079	0.145	0.102
5	0.152	0.112	0.142	0.126
6	0.168	0.131	0.163	0.144
7	0.185	0.159	0.135	0.148
8	0.172	0.145	0.142	0.155
9	0.150	0.139	0.138	0.124
10	0.153	0.155	0.128	0.122
11	0.143	0.162	0.155	0.142
12	0.153	0.138	0.129	0.160
13	0.151	0.149	0.120	0.135
14	0.169	0.158	0.108	0.129
15	0.145	0.133	0.153	0.122
16	0.157	0.142	0.212	0.094
17	0.131	0.120	0.136	0.113
18	0.143	0.143	0.098	0.118
19	0.113	0.146	0.061	0.089
20	0.134	0.114	0.108	0.097
21	0.120	0.160	0.095	0.123
22	0.108	0.098	0.089	0.163
23	0.115	0.096	0.180	0.078
24	0.137	0.173	0.175	0.036
25	0.146	0.080	0.125	0.184
26	0.107	0.156	0.077	0.056
27	0.167	0.188	0.043	0.156
28	0.181	0.096	0.100	0.185
29	0.165	0.200	0.222	0.048
30	0.082	0.083	0.071	

Table 2b

RAW DATE-RELATED PROMOTION RATES
1973 SURVEY

DATE	*PUBLIC UNIVERSITY*	*PRIVATE UNIVERSITY*	*PUBLIC COLLEGE*	*PRIVATE COLLEGE*
1947	0.066	0.064	0.027	0.041
1948	0.078	0.068	0.012	0.094
1949	0.057	0.040	0.075	0.053
1950	0.065	0.056	0.043	0.069
1951	0.071	0.046	0.042	0.048
1952	0.073	0.051	0.029	0.073
1953	0.062	0.048	0.032	0.054
1954	0.070	0.065	0.027	0.060
1955	0.063	0.052	0.025	0.052
1956	0.074	0.060	0.043	0.061
1957	0.072	0.059	0.048	0.064
1958	0.077	0.053	0.055	0.070
1959	0.077	0.070	0.035	0.074
1960	0.084	0.081	0.072	0.094
1961	0.080	0.075	0.063	0.068
1962	0.085	0.088	0.072	0.081
1963	0.097	0.091	0.066	0.089
1964	0.099	0.095	0.095	0.075
1965	0.108	0.110	0.102	0.116
1966	0.123	0.106	0.119	0.100
1967	0.139	0.119	0.117	0.142
1968	0.156	0.159	0.177	0.158
1969	0.181	0.154	0.208	0.118
1970	0.190	0.140	0.223	0.135
1971	0.182	0.127	0.190	0.114
1972	0.197	0.143	0.239	0.143

have low raw tenure rates because the young faculty have not yet had time to make a case for promotion. Raw tenure rates thus confound the effects of age structure and market pressure. A statistical model is necessary to separate these effects.[3]

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[3] The numbers reported in this and following tables are all unweighted and thus not strictly comparable to the results from the 1969 ACE-Carnegie Survey reported by Trow (5). Both surveys were stratified by type and selectivity by institution. Weighting would make the magnitude of the numbers the same as the magnitude of the entire population (institutions of higher education). However, since the sample was not stratified to be representative of institutions according to their tenure ratios, it is possible that blowing up the sample using institutional weights could be misleading, since our interest here is to study promotion to tenure of those within the sample.

3. A Statistical Model[4]

The observations that we seek to explain with our model can be summarized by a matrix whose dimensions are years since highest degree, i, and date, t. An element in the matrix is P_{it}, the number of faculty of age i at date t who have not yet received tenure. If we consider a cohort of those who received their highest degree at a particular date, between any two years $P_{it} - P_{i+1,t+1} = S_{it}$ will have received tenure.

With the S_{it} as observations of "successes" we seek to estimate ϕ_{it}, the probability of obtaining tenure as a faculty member moves from age i at date t to age $i+1$ at date $t+1$. This estimated probability depends on an age effect, a_i, and a date effect, b_t. In particular, we fit a logistic function which assumes that:

$$\log \frac{\phi_{it}}{1 - \phi_{it}} = a_i + b_t$$

or

$$\phi_{it} = \frac{e^{a_i+b_t}}{1 + e^{a_i+b_t}} = \frac{A_i B_t}{1 + A_i B_t}$$

where $A_i = e^{a_i}$ and $B_t = e^{b_t}$.

The logit function can be thought of as the log of the odds of getting tenure for an individual i years past his highest degree and the date effects can be thought of as a sort of "correction" to this odds ratio that depends on market conditions at date t. If market conditions had no effect on a faculty member's chance of promotion, then the b_t would be equal to zero and the B_t equal to 1. The ϕ_{it} would then be independent of time, or

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[4] The statistical model is described in greater detail in Appendix I.

$$\phi_{it} = \phi_i = \frac{A_i}{1 + A_i} \quad .$$

An age effect, A_i, of .10 would mean that if one did not yet have tenure at i years from one's highest degree, the odds in favor of obtaining tenure between that year and the next would be .10, or 1 to 10. The corresponding probability is .09, or 1/11. A date effect, B_t of, say, .5, would imply that because of the market at time t, the actual odds ratio of obtaining tenure between year i and $i+1$ and between dates t and $t+1$ would be only half as great as would be predicted on the basis of age alone. (The corresponding probability is .048.) Similarly, a B_t of 1.5 would imply a probability of getting tenure of .13, or an odds ratio of .15 (that is, $.1 \times 1.5 = A_i \times B_t$). In years of increasing demand for faculty, we should expect the B_t to be greater than 1. In years of declining demand, we would expect the B_t to be less than 1 if our hypothesis of tenure as a method of competitive adjustment is correct.

Given the age and date effects, it is possible for any given date to calculate the corresponding probability frequency function and the cumulative distribution function for the time to tenure. We can find the medians of these distributions, and these "date-corrected" medians allow us to make comparisons across types of institutions and among fields that are easily understood intuitively. The date-corrected median for year t can be interpreted as the median time to tenure that would be experienced by the cohort that entered academia in year t if conditions did not change thereafter. After examples of age and date effects are shown below it is these date-corrected medians that will be used to illustrate the results of our estimation.

4. Results[5]

The estimated age and date effects, for data from the 1973 ACE Survey, are shown in Tables 3 and 4. Taken by themselves, they are not particularly easy to interpret. It appears that, for most types of institution, the age effect is largest (i.e., the odds of promotion are

Table 3

LOGIT DATE EFFECTS
1973 SURVEY

DATE	*PUBLIC UNIVERSITY*	*PRIVATE UNIVERSITY*	*PUBLIC COLLEGE*	*PRIVATE COLLEGE*
1946	0.52	0.39	0.12	0.59
1947	0.50	0.59	0.23	0.36
1948	0.64	0.65	0.10	0.92
1949	0.49	0.39	0.79	0.53
1950	0.62	0.60	0.44	0.73
1951	0.73	0.53	0.45	0.53
1952	0.79	0.62	0.32	0.89
1953	0.66	0.61	0.35	0.65
1954	0.73	0.80	0.28	0.70
1955	0.63	0.63	0.27	0.59
1956	0.72	0.71	0.44	0.67
1957	0.68	0.67	0.49	0.68
1958	0.71	0.58	0.55	0.72
1959	0.69	0.76	0.34	0.74
1960	0.76	0.89	0.68	0.98
1961	0.72	0.81	0.58	0.70
1962	0.78	0.98	0.70	0.85
1963	0.93	1.03	0.64	0.96
1964	0.99	1.13	0.98	0.81
1965	1.12	1.33	1.08	1.32
1966	1.33	1.31	1.34	1.12
1967	1.56	1.55	1.30	1.71
1968	1.83	2.29	2.18	2.03
1969	2.24	2.33	2.78	1.48
1970	2.42	2.14	3.21	1.76
1971	2.24	1.87	2.64	1.48
1972	2.34	1.98	3.32	1.87

[5] A complete tabulation of the results is given in Appendix 2. Selected tables and graphs are also presented in the body of the report.

Table 4

LOGIT AGE EFFECTS
1973 SURVEY

AGE	*PUBLIC UNIVERSITY*	*PRIVATE UNIVERSITY*	*PUBLIC COLLEGE*	*PRIVATE COLLEGE*
1	0.019	0.012	0.028	0.026
2	0.037	0.017	0.047	0.033
3	0.082	0.044	0.095	0.053
4	0.114	0.073	0.130	0.106
5	0.154	0.109	0.135	0.137
6	0.182	0.136	0.169	0.163
7	0.216	0.177	0.148	0.172
8	0.203	0.162	0.154	0.184
9	0.173	0.156	0.152	0.141
10	0.178	0.182	0.142	0.138
11	0.161	0.190	0.173	0.161
12	0.169	0.155	0.137	0.184
13	0.162	0.164	0.124	0.149
14	0.181	0.172	0.099	0.140
15	0.149	0.143	0.147	0.125
16	0.166	0.153	0.213	0.093
17	0.134	0.123	0.129	0.115
18	0.149	0.152	0.088	0.117
19	0.114	0.160	0.049	0.085
20	0.140	0.117	0.095	0.093
21	0.124	0.176	0.087	0.122
22	0.112	0.100	0.080	0.173
23	0.121	0.100	0.179	0.073
24	0.148	0.189	0.166	0.031
25	0.156	0.070	0.110	0.191
26	0.103	0.145	0.070	0.049
27	0.162	0.175	0.038	0.161
28	0.175	0.075	0.097	0.184
29	0.153	0.179	0.232	0.043
30	0.066	0.067	0.046	

greatest) from 7 to 12 years after receipt of Ph.D. It appears that the maximum values of the age effects are reached earliest in public universities. The age effects become easier to interpret if we convert the estimated odds into probabilities and construct the corresponding probability distribution function, we can then calculate a cumulative distribution function from it (which tells us the chance of promotion at or before

a particular age, assuming that date has no effect), and examine the median time to tenure, by type of institution. In Table 5, these medians along with the interquartile range,[6] allow us to contrast differences in time to tenure for different types of institution. As estimated from age

Table 5

Median and Interquartile Ranges of Time to Tenure
Uncorrected for Date Effects

	Median	Interquartile Range
Public Universities	6.7	6.4
Private Universities	7.9	6.9
Public Four Year	6.9	7.8
Private Four Year	7.3	7.3

effects alone (assuming that the date effects are constant over time and equal to 1), the time to tenure is shorter in public institutions than in private institutions. The dispersion of time to tenure is least for public universities and greatest for public 4 year colleges.

The date effects also show a roughly similar pattern by type of institution. Generally, they are less than one (i.e., the odds of getting tenure are less than what would be predicted on the basis of age alone) until the early 1960's, when they begin to rise rapidly. This rise levels off at different dates for different types of institution. For public universities the maximum is reached in 1970, for private universities in 1969.

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[6] The interquartile range is the difference in years between the time to tenure before which 25% of those promoted have been promoted and the time to tenure before which 75% of those promoted have been promoted.

This pattern is not as marked for 4 year institutions. Public colleges hardly seem to level off at all, except for a dip in 1971. Private colleges peak in 1968, but then the date effects seem to fluctuate.

An intuitively understandable interpretation of the way that the date effects influence the time to tenure based on age alone is found by examining the date-corrected median times to tenure. As was described above, the date-corrected median time to tenure in year t can be interpreted as the median time to tenure that would be experienced by the cohort that enters the academic labor market in year t if market conditions were to remain unchanged thereafter. These are calculated by taking the age effects and, for each year, applying the appropriate date effect. The corresponding probability distribution is then found and the median of the corresponding cumulative distribution is the date-corrected median time to tenure. These are shown in Table 6, for the dates after 1950. For universities, the public medians are uniformly lower than the private medians as can be easily seen in Figure 1. For four year colleges, before 1965, the date-corrected median is higher for public institutions. Thereafter, the median for private institutions is higher. This change may be due, in part, to the fact that tenure systems were not adopted by many state colleges until the late 1950's. It should also be noted that, even as late as 1972, the date-corrected medians were falling, although they were declining at a lower rate than in the 1960's.

The date-corrected median times to tenure by broad field are presented in Table 7, for public universities and in Table 8, for private universities. The pattern by field is similar to that for the aggregate--the median time to tenure falls rapidly after 1961, levelling off in 1968 for private universities, but continuing to fall until 1970 for public universities. This

Table 6

MEDIAN AGES TO TENURE
1973 SURVEY

DATE	*PUBLIC UNIVERSITY*	*PRIVATE UNIVERSITY*	*PUBLIC COLLEGE*	*PRIVATE COLLEGE*
1950	8.58	10.02	12.86	8.80
1951	7.81	10.50	12.45	11.01
1952	7.56	9.88	16.47	7.75
1953	8.28	9.98	15.34	9.64
1954	7.85	8.91	19.39	9.09
1955	8.47	9.86	20.23	10.32
1956	7.85	9.40	12.94	9.43
1957	8.13	9.63	11.66	9.33
1958	7.95	10.19	10.65	8.94
1959	8.01	9.08	15.73	8.75
1960	7.69	8.46	9.08	7.36
1961	7.87	8.86	10.24	9.09
1962	7.59	8.02	8.90	7.91
1963	6.94	7.85	9.53	7.45
1964	6.74	7.51	7.01	8.22
1965	6.39	6.94	6.57	6.29
1966	5.88	6.99	5.76	6.84
1967	5.47	6.55	5.85	5.56
1968	5.07	5.60	4.42	5.14
1969	4.63	5.56	3.87	5.93
1970	4.48	5.75	3.62	5.49
1971	4.63	6.08	3.96	5.93
1972	4.54	5.94	3.57	5.34

Figure 1

Median Times to Tenure

Public Universities (———)

Private Universities (- - - -)

1973 Survey

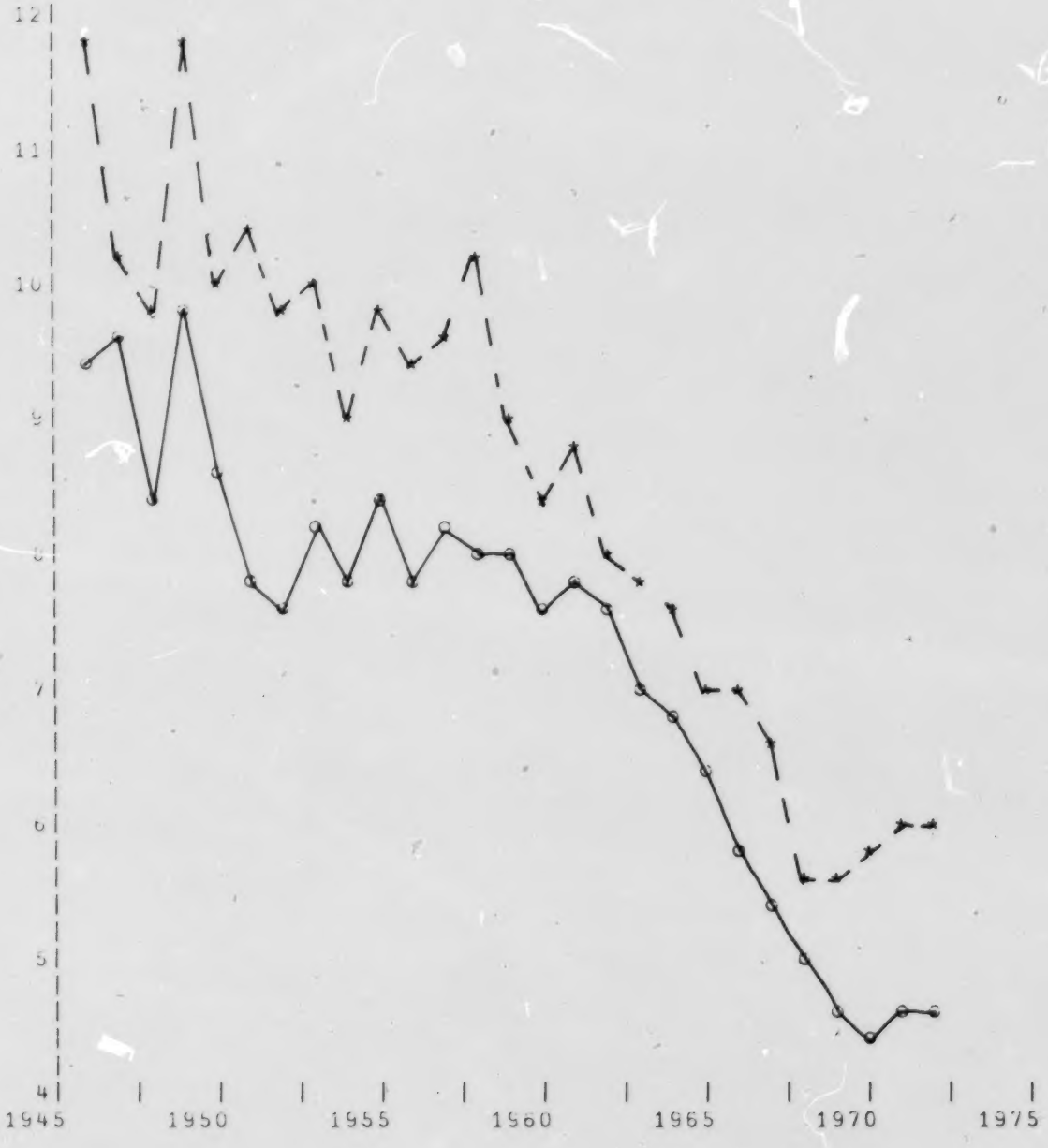


Table 7

MEDIAN AGES TO TENURE
1973 SURVEY / PUBLIC UNIVERSITIES

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1950	8.35	10.16	9.05	13.20	8.51	12.79
1951	8.16	9.47	7.98	8.54	7.20	8.08
1952	7.40	6.12	7.44	7.18	7.88	7.92
1953	10.05	15.68	8.58	7.64	11.69	15.03
1954	8.29	10.76	8.33	6.60	7.38	9.95
1955	12.58	10.86	10.81	9.82	9.29	7.29
1956	10.84	7.81	11.01	8.05	9.12	13.07
1957	8.07	6.25	10.03	8.03	8.45	6.83
1958	6.75	9.74	8.32	8.57	9.95	7.59
1959	8.11	7.06	10.65	7.71	11.08	6.89
1960	8.62	7.04	9.35	6.68	9.37	6.52
1961	9.51	10.43	8.83	7.62	9.59	8.82
1962	7.36	6.80	7.81	7.43	8.42	8.81
1963	7.91	6.62	7.83	6.57	6.57	7.91
1964	7.59	8.05	7.01	6.68	6.71	6.79
1965	6.50	5.88	6.04	6.58	6.10	6.35
1966	6.28	5.00	5.48	6.87	5.68	5.13
1967	6.25	5.06	5.11	6.05	4.96	4.93
1968	5.73	4.45	5.30	5.93	5.38	4.11
1969	5.52	3.85	4.28	5.75	4.39	4.13
1970	5.30	4.26	3.99	5.47	4.22	3.65
1971	5.08	4.05	4.50	5.94	4.11	3.79
1972	4.87	5.10	3.81	6.06	4.11	4.34
MED	7.23	5.74	6.92	7.11	5.50	5.87
IQR	5.74	5.26	6.55	5.61	6.69	6.56
RATIO	0.79	1.09	0.95	0.79	1.01	1.13

Table 8

MEDIAN AGES TO TENURE
1973 SURVEY / PRIVATE UNIVERSITIES

DATE	*BIOLOGICAL SCIENCES*	*ENGINEERING*	*HUMANITIES*	*PHYSICAL SCIENCES*	*SOCIAL SCIENCES*	*EDUCATION*
1950	15.12	10.12	12.86	11.57	7.09	10.24
1951	15.89	10.74	10.82	6.74	13.25	10.57
1952	15.22	8.34	9.25	11.69	9.05	15.27
1953	10.52	6.75	6.88	9.41	13.05	10.22
1954	10.46	8.35	9.64	7.12	9.13	17.86
1955	11.39	13.02	12.80	9.45	13.07	13.72
1956	13.47	9.76	9.80	8.59	8.82	10.91
1957	20.39	6.96	7.83	11.37	8.33	10.09
1958	20.47	13.08	8.51	9.62	9.19	9.53
1959	11.53	10.13	7.56	8.04	9.82	7.98
1960	10.11	7.55	10.55	8.02	7.79	10.72
1961	8.63	14.06	12.12	8.72	9.64	7.16
1962	11.40	6.50	10.67	7.60	7.62	5.70
1963	9.93	8.83	7.54	7.19	7.29	5.79
1964	8.98	8.96	7.65	7.15	9.27	5.94
1965	12.54	5.73	5.99	7.23	7.08	7.58
1966	11.80	5.80	6.30	8.31	6.47	10.06
1967	10.82	5.99	5.71	7.23	5.78	5.34
1968	7.57	5.70	4.89	6.18	5.27	5.62
1969	8.17	4.76	4.75	6.48	4.89	5.97
1970	8.67	4.90	4.72	6.08	5.88	4.92
1971	10.67	5.32	5.15	7.12	4.98	6.00
1972	8.75	6.37	5.94	6.11	4.91	5.73
MED	10.60	6.79	7.27	7.82	7.44	7.57
IQR	7.28	5.75	5.70	5.61	7.37	5.99
RATIO	0.69	0.85	0.78	0.72	0.99	0.79

general observation is illustrated in Figure 2 for the physical sciences and in Figure 3 for the social sciences. It is interesting to note that the rapid decline in the median time to tenure began in 1956 in the physical sciences, while this did not occur until 1959 in the social sciences. Further work should relate these differential changes in median times to tenure to changes in the ratio of non-academic to academic demand.

For both public and private universities, it appears that the date-corrected median times to tenure estimated by the logit model are longest in the biological and physical sciences. This seems curious, since the non-academic market for natural scientists is certainly more important than the non-academic market for Ph.D.'s in the humanities. Two things, however, should be noted. First, the decline in the time to tenure began earlier in the natural sciences than in the humanities and social sciences, and for the period 1956-1960, median times to tenure in the natural sciences were low relative to other fields. Second, in the 1960's the differences between median times to tenure among all fields narrowed in both public and private universities. When we looked at the inter-quartile range for median times to tenure by field in the 1960's, there was much more overlap over fields using this measure than the point estimates would indicate.

There are also two conceptual points that need further investigation before we can interpret this result of field differences. First, our measure of time to tenure is time since Ph.D. It is possible that, in the humanities, it takes a long time to earn a Ph.D., but thereafter progression to tenure is quite regular. The adjustment of supply to demand takes place in the time to completion of Ph.D. rather than the time from Ph.D. to tenure.

Figure 2

Median Times to Tenure

Physical Sciences

Public Universities (——)

Private Universities (- - - -)

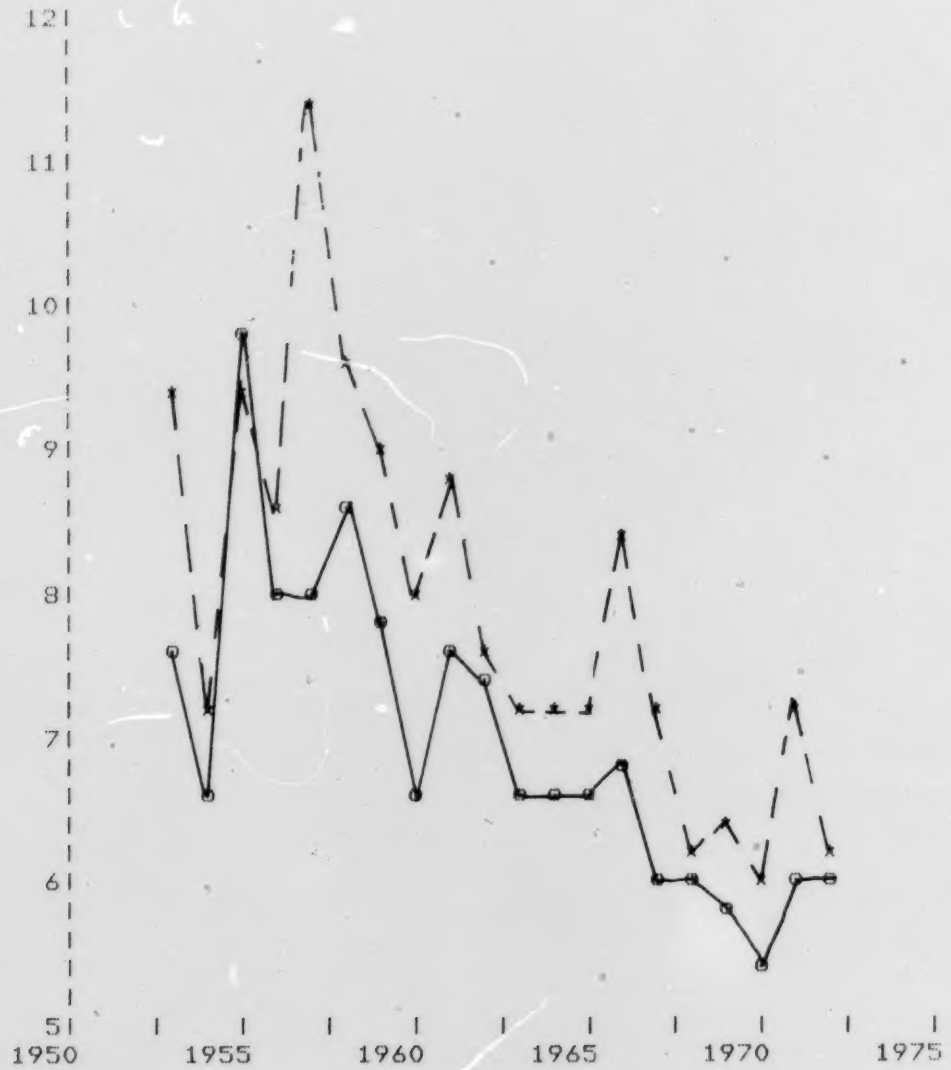


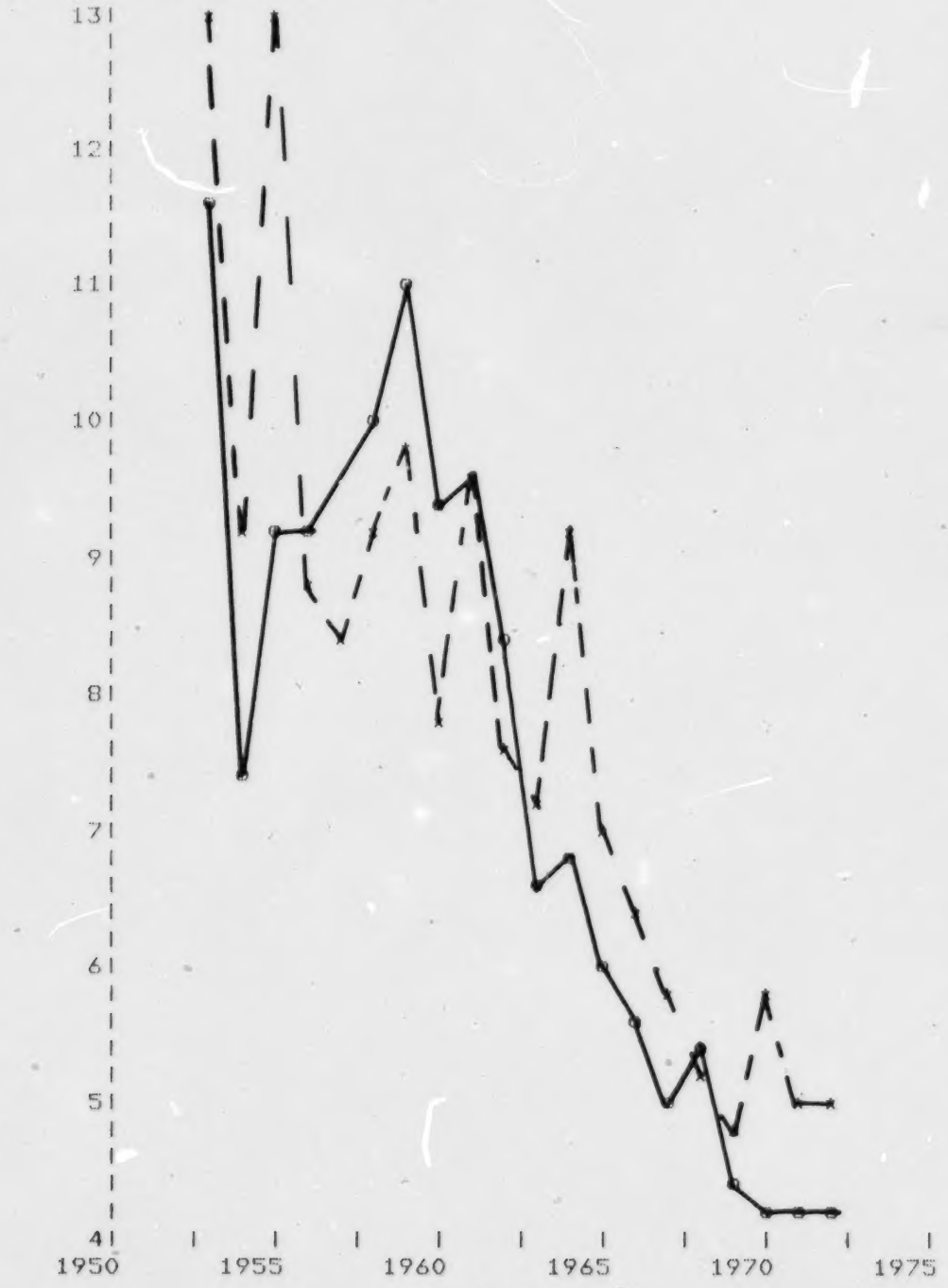
Figure 3

Median Times to Tenure

Social Sciences

Public Universities (———)

Private Universities (- - - - -)



In the sciences, on the other hand, the time to completion may be fairly constant, but post-doctoral fellowships prolong the time from Ph.D. to entry to tenure track positions. The "true" adjustment variable for humanities, then, would be time to tenure corrected for time to Ph.D., while in the sciences, it would be time to tenure corrected for duration of post-doctoral work. We do not have the data to make all these corrections, but they should be taken into account when we interpret the date-corrected medians.

The other point concerns the role of changes of tenure rate as a method to increase the supply of Ph.D.'s to the academic, as opposed to the non-academic, market. In the natural sciences, a relatively large share of demand for Ph.D.'s comes from the non-academic market. Here, small adjustments in tenure rates may induce the required supply response as academic demand increases. The source of additional supply, at least initially, is existing Ph.D.'s. In the humanities, on the other hand, the non-academic market is virtually non-existent. When academic demand increases, potential supply must be attracted by increasing the number of graduate students. The lags in this process of adjustment may be considerably longer and it may be that a relatively large change in the rate of promotion to tenure is necessary to induce the required supply response in the short run. Implicit in this argument is a model of dynamic adjustment of supply and demand similar to that of Freeman (3). The purpose of this paper is more statistical description than model building. However, an obvious next step involves explaining the age and date effects with a model of this sort.

5. Some Qualifications

Before we summarize our results, a few notes of caution in interpretation should be sounded. The most important has to do with the data, which

come from a survey of teaching faculty within academia. Faculty that have left academia because they did not get tenure are not included in our sample. Thus, our estimates of tenure rates are probably overstated, particularly for the older faculty cohorts. The way to investigate the extent of the bias would be, for example, to look at the National Research Council longitudinal survey of doctoral scientists and engineers, which includes Ph.D.'s both within and outside academia. It is unlikely, however, that the qualitative aspects of our estimates would be changed.

Another qualification that stems from the nature of the sample concerns the independence of the experience of individuals. Strictly speaking, the assumption of independence is implicit in the statistical model that we use. However, the experiences of individuals within the same institution will clearly not be independent, even given age and date. If only a small number of institutions are sampled, then this assumption must be questioned. Nevertheless, in the 1973 Survey, and particularly for universities, we feel that this lack of independence is unlikely to seriously bias our estimates.

The third qualification relates to the point discussed in the previous section concerning different career patterns by field. If there are systematic differences in career patterns (time to complete Ph.D., post-docs, etc.), then the age effects will be incorrect to the extent that these differences have not been taken into account. However, if these systematic differences do not change over time, the date effects, which are estimated conditional on age, will not be biased. On the other hand, if career patterns change as the result of market influences, the date effects will reflect these changes, which are, in fact, changes in the "true" age effects.

Finally, it should be remembered that our model of the process of promotion to tenure leaves out a lot of things that all of us who are academics know to be important. Change in quality of faculty by cohort is perhaps the most obvious example. Suppose that physicists trained after 1960 are simply better physicists than those trained previously. Until the market adjusts to this higher level of quality in post-1960 cohorts, for example, by raising standards for promotion, post-1960 cohorts will have a greater chance of promotion not because of "the market" but because they are perceived as "better" than earlier cohorts. Our model is not refined enough to pick up these differences.

In spite of these qualifications, however, we feel that this model does describe in a concise and quantifiable manner an important aspect of adjustment in the market for faculty.

6. Conclusions

In this paper, we have used a statistical model to estimate time from Ph.D. to tenure. We have been able to separate the effects of time since Ph.D. (age effects) from effects that are associated with changes in market conditions (date effects). We find that the tenure rate did, indeed, increase during the period of rapid growth in academia from 1960 to 1968 in all types of institution and in all fields within these institutions. After 1968, the tenure rate continued to increase in public institutions, but more slowly. However, in private institutions, the tenure rate remained constant or declined between 1968 and 1972. Thus it would appear that the tenure rate did behave as an economic variable in the sense that higher tenure rates occurred at the same time as the rapid increase in employment in academia.

In private institutions, which were relatively harder hit by the declining rate of increase in enrollments in the late 1960's, we see quite rapid downward adjustment of tenure rates at the same time.

We examined the tenure rate by broad field for universities and found the same general pattern as was found by type of institution. In public universities, the tenure rate rose more or less continuously from 1960 to 1972. In private universities, the median time to tenure also fell after 1960, but levelled off and began to rise again after 1968.

Contrary to our expectations, it would appear that the median time to tenure is longer in the physical and biological sciences than in the humanities and social sciences, in both public and private universities. This may be a result of post-doctoral fellowships in the sciences delaying entry into tenure track positions, or it may be a result of the academic sector having a relatively smaller share of total demand for Ph.D.'s which would require less adjustment in rates of promotion to tenure to evoke a given supply response in these fields. This question, and the problem of relating the date effects that we have found to other observable changes in the academic labor market are important directions for future research on academic labor markets. It is necessary, first, to know what we need to explain. We hope this paper has been a step in that direction.

7. References

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Appendix 1. A Two-Way Logit Model for the Estimation of Age and Date Effects.

We observe a sample of K persons in a particular year. For each person we observe: (1) his "age" (e.g., the number of years since the Ph.D.); (2) whether or not tenure has already been obtained and, if so, at what date; and (3) some other characteristics (e.g., type of institution). Counting time in years, we let T_k denote the first age at which k has tenure, i.e., if k gets tenure between ages $(i-1)$ and i, then $T_k = i$ $(i \geq 0)$. Note that T_k need not be finite. Let $p_k(i)$ denote the conditional probability that $T_k = i$, given k's characteristics. Since T_k need not be finite, the sum of the probabilities $p_k(i)$ over years i could be less than 1. We assume that, given the characteristics of the persons, the random variables T_k are mutually independent. We also assume that $T_k > 0$ (alternatively, we consider only such persons).

At the time of the sample survey, person k has age I_k. Therefore, if $T_k \leq I_k$ (person k already has tenure), then we observe T_k. Otherwise, we only observe that $T_k > I_k$; we denote this outcome by the symbol $\emptyset$. Accordingly, our observation about person k's time to tenure is

$$Y_k \equiv \begin{cases} T_k \text{ , if } T_k \leq I_k \text{ ,} \\ \emptyset \text{ , if } T_k > I_k \text{ .} \end{cases}$$

The likelihood function for Y_k is

$$(1) \qquad L_k(Y_k) = \begin{cases} p_k(Y_k) \text{ , if } Y_k \neq \emptyset \text{ ,} \\ \sum_{i>I_k} p_k(i) \text{ , if } Y_k = \emptyset \text{ .} \end{cases}$$

It will be convenient to express this likelihood function in terms of the probabilities of transition from nontenure to tenure. Define k's <u>tenure rate at age i by</u>

$$\phi_k(i) \equiv \text{Prob}\ (T_k = i + 1 \mid T_k > i)$$

$$= \frac{p_k(i+1)}{\sum_{j>i} p_k(j)} ,$$

where it is to be understood that the sum includes the term $j = \infty$ (k never gets tenure). Then

$$1 - \phi_k(i) = \frac{\sum_{j>i+1} p_k(j)}{\sum_{j>i} p_k(j)} ,$$

and

$$p_k(i) = \phi_k(i-1) \prod_{j=0}^{i-2} [1 - \phi_k(j)] ,$$

$$\sum_{j>i} p_k(i) = \prod_{j=0}^{i-1} [1 - \phi_k(j)] .$$

Let $X_k(i) = 1$ if k does not have tenure at age i , and zero otherwise. (Recall $X_k(0) = 1$). We can write the likelihood function L_k as

$$(2) \qquad L_k(Y_k) = \begin{cases} \phi_k(Y_k - 1) \prod_{j=0}^{I_k-1} [1 - \phi_k(j)]^{X_k(j+1)} & , \text{ if } Y_k \neq \emptyset , \\ \prod_{j=0}^{I_k-1} [1 - \phi_k(j)]^{X_k(j+1)} & , \text{ if } Y_k = \emptyset . \end{cases}$$

Notice that $[X_k(i) - X_k(i + 1)] = 1$ if k first has tenure at age $(i + 1)$, and is zero otherwise. Hence

$$(3) \qquad \prod_{j=0}^{I_k-1} \phi_k(j)^{X_k(j) - X_k(j+1)} = \begin{cases} \phi_k(Y_{k-1}) & \text{if } Y_k \neq \emptyset , \\ 1 , & \text{if } Y_k = \emptyset . \end{cases}$$

Combining (2) and (3), we see that the natural logarithm of the likelihood function L_k is

$$(4) \qquad \ell_k(Y_k) \equiv \ell n\, L_k(Y_k)$$

$$= \sum_{i=0}^{I_k-1} [X_k(i) - X_k(i + 1)]\, \ell n\, \phi_k(i)$$

$$+ \sum_{j=0}^{I_k-1} X_k(i + 1) \ell n[1 - \phi_k(i)] .$$

Since the observations Y_k are mutually independent, given the characteristics of the persons, the logarithm of the sample likelihood function is

$$(5) \qquad \ell(Y_1,..,Y_k) = \sum_k \ell_k(Y_k) .$$

Equations (4) and (5) are the basis of all the subsequent analysis.

Suppose first that we have a group of persons who are homogeneous with respect to all characteristics other than the "age" I_k at the time of the survey. Assume that a person's tenure rate at age i depends on i and on the calendar date at which the subject reaches age i. In other words, there are parameters ϕ_{it} such that, if person k has age i in year t then

$$\phi_k(i) = \phi_{it} \quad . \tag{6}$$

Let P_{it} denote the number of persons of age i who do not yet have tenure at date t, and define

$$N_{it} = P_{i+1,t+1} \quad ,$$

$$S_{it} = P_{it} - P_{i+1,t+1} \quad .$$

Thus S_{it} is the number of persons untenured at age i and date t who succeed in obtaining tenure during the following year, and N_{it} is the number not successful. In terms of these numbers, the log-likelihood function (4) - (5) can be written as

$$\ell(Y_1,..,Y_k) = \sum_{i=0}^{I-1} \sum_{t=0}^{T-1} [S_{it} \ell n \ \phi_{it} + N_{it} \ell n \ (1 - \phi_{it})] \quad , \tag{7}$$

where I is the largest age represented in the sample, and the calendar dates run from 0 to T.

We now consider a particular hypothesis about the parameters ϕ_{it}, namely, that the logarithm of the <u>odds</u> of getting tenure is the sum of an "age effect" and a "date effect". To be precise, we

consider the hypothesis that

$$\phi_{it} = \frac{A_i B_t}{1 + A_i B_t} \quad , \tag{8}$$

or equivalently

$$\ell n \left(\frac{\phi_{it}}{1 - \phi_{it}} \right) = \phi_i + \beta_t \quad , \tag{9}$$

where

$$\phi_i \equiv \ell n \, A_i \quad , \quad \beta_t \equiv \ell n \, B_t \quad . \tag{10}$$

We shall actually call the parameters A_i the <u>age effects</u> and the parameters B_t the <u>date effects</u>. Notice that we need a further condition to identify the parameters A_i and B_t, since, in (8) if we multiply all the age effects by a constant, and divide all the data effects by the same constant, the tenure rates ϕ_{it} are left unchanged. This further condition will be a "normalization" equation of the form

$$\prod_t B_t^{w_t} = 1 \quad , \tag{11a}$$

or equivalently

$$\sum_t w_t \beta_t = 0 \quad , \tag{11b}$$

where the w_t are some fixed weights whose sum is 1. We shall discuss the choice of weights later.

With the hypothesis (8) the log-likelihood function (7) becomes

$$(12)\qquad \ell(Y_1,..,Y_k) = \sum_{it}\left[S_{it}\ell n\left(\frac{A_iB_t}{1+A_iB_t}\right) + N_{it}\ell n\left(\frac{1}{1+A_iB_t}\right)\right]$$

$$= \sum_i S_{i.}\ell n\, A_i + \sum_t S_{.t}\ell n\, B_t$$

$$- \sum_{it} P_{it}\ell n\,(1+A_iB_t)\ ,$$

where

$$(13)\qquad S_{i.} \equiv \sum_t S_{it}\ ,\quad S_{.t} \equiv \sum_i S_{it}\ .$$

The first-order conditions for a maximum of the log-likelihood ℓ with respect to the parameters A_i and B_t are

$$(14)\qquad \frac{\partial \ell}{\partial A_i} = \frac{S_{i.}}{A_i} - \sum_t \frac{P_{it}B_t}{1+A_iB_t} = 0\ ,\ \text{all}\ \ i\ ;$$

$$\frac{\partial \ell}{\partial B_t} = \frac{S_{.t}}{B_t} - \sum_i \frac{P_{it}A_i}{1+A_iB_t} = 0\ ,\ \text{all}\ \ t\ ;$$

or equivalently,

$$(15)\qquad A_i = S_{i.} \Big/ \sum_t \frac{P_{it}B_t}{1+A_iB_t}\ ,\ \text{all}\ \ i\ ;$$

$$B_t = S_{.t} \Big/ \sum_i \frac{P_{it}A_i}{1+A_iB_t}\ ,\ \text{all}\ \ t\ .$$

To these equations should be added the normalization equation, (11).

Equations (15) suggest an iterative algorithm for calculating the maximum-likelihood estimates, A_i^* and B_t^*. Define the mapping $(A', B') = F(A, B)$ by

$$A_i' = S_{i.} \Big/ \sum_t \frac{P_{it} B_t}{1 + A_i B_t} ,$$

$$B_t' = S_{.t} \Big/ \sum_t \frac{P_{it} A_i}{1 + A_i B_t} . \tag{16}$$

The maximum-likelihood estimates (MLE's) A_i^* and B_t^*, then satisfy the fixed-point condition

$$(A^*, B^*) = F(A^*, B^*) , \tag{17}$$

where

$$A^* \equiv (A_i^*), \quad B^* \equiv (B_t^*) .$$

We take initial values

$$B_t^0 = 1 , \text{ all } t ,$$

$$A_i^0 = S_{i.} / N_{i.} , \text{ all } i , \tag{18}$$

and calculate successive pairs (A^n, B^n) by

$$(A^n, B^n) = F(A^{n-1}, B^{n-1}) , \quad n \geq 1 , \tag{19}$$

until successive differences appear sufficiently small. Note that the A_i^0 are the MLE's of the age effects under the hypothesis that all date effects are 1. This algorithm has performed well on our

data thus far. The appendix to this section shows that the algorithm is locally stable in a neighborhood of a pair (A^*, B^*) of MLE's.

To test a null hypothesis such as $B_t = 1$ for all t, one can use an asymptotic form of the maximum-likelihood-ratio test. For example, let ℓ_1^* be the maximum of ℓ under the hypothesis (8), and let ℓ_0^* be the maximum of ℓ under the hypothesis of identical date effects:

(20) $\qquad B_t = 1$, all t;

then for large samples, under the "null" hypothesis (20) the distribution of $2(\ell_1^* - \ell_0^*)$ will be approximately a chi-squared distribution with $(T - 1)$ degrees of freedom.

The Case of More than One Group of Persons

We now consider the case in which the persons in the sample are grouped by some characteristics, e.g., type of institution. The same analysis could be applicable to comparing the results of different sample surveys.

Let the groups be indexed by $g = 1,..,G$, and let ϕ_{git} denote the tenure rate for a person in group g who has age i at date t. We are particularly concerned with testing the hypothesis that the date effects are the same across groups. For this question, the null hypothesis is

$$\phi_{git} = \frac{A_{ig}B_t}{1 + A_{ig}B_t} \quad , \text{ all } g , i , t ; \tag{21}$$

and the alternative hypothesis is

$$\phi_{git} = \frac{A_{ig}B_{gt}}{1 + A_{ig}B_{gt}} \quad , \text{ all } g , i , t .$$

To use the large-sample maximum-likelihood test, we calculate MLE's under the two hypotheses. The MLE's under the alternative hypothesis are, of course, obtained by applying the preceding analysis to each group individually. Let ℓ_g^* denote the maximum of the log-likelihood for group g.

To obtain the MLE's under the null hypothesis, we combine (4) and (21) to get the log-likelihood function

$$(22) \qquad \ell = \sum_{git} \left[S_{git} \ln \left(\frac{A_{gi} B_t}{1 + A_{gi} B_t} \right) + N_{git} \ln \left(\frac{1}{1 + A_{gi} B_t} \right) \right]$$

$$= \sum_{gi} S_{gi.} \ln A_{gi} + \sum_{t} S_{..t} \ln B_t$$

$$- \sum_{git} P_{git} \ln (1 + A_{gi} B_t) \quad .$$

The first-order conditions for a maximum of ℓ are

$$\frac{\partial \ell}{\partial A_{gi}} = \frac{S_{gi.}}{A_{gi}} - \sum_{t} \frac{P_{git} B_t}{1 + A_{gi} B_t} = 0 \ ,$$

$$\frac{\partial \ell}{\partial B_t} = \frac{S_{..t}}{B_t} - \sum_{gi} \frac{P_{git} A_{gi}}{1 + A_{gi} B_t} = 0 \ .$$

These may be rewritten as

$$A_{gi} = S_{gi.} \Big/ \sum_{t} \left(\frac{P_{git} B_t}{1 + A_{gi} B_t} \right),$$

$$B_t = S_{..t} \Big/ \sum_{gi} \left(\frac{P_{git} A_{gi}}{1 + A_{gi} B_t} \right).$$

Note the similarity between these equations and (15). Again, these equations suggest an iterative algorithm for calculating the MLE's. We shall write the iteration formula in a way that suggests how one could use the basic calculation for the one-group case as a "subroutine" for the present case. Let A_{gi}^k and B_i^k be the approximations to the MLE's obtained in iteration k. Define

$$C^k_{gt} \equiv \sum_i \frac{P_{git} A^k_{gi}}{1 + A^k_{gi} B^k_t} ,$$

(23)
$$W^k_{gt} \equiv C^k_{gt} \Big/ \sum_{\gamma=1} C^k_{\gamma t} ,$$

$$B^k_{gt} \equiv S_{g.t} \Big/ C^k_{gt} .$$

Iteration $(k + 1)$ is now defined by

$$A^{k+1}_{gi} = S_{gi.} \Big/ \sum_t \frac{P_{git} B^k_t}{1 + A^k_{gi} B^k_t} ,$$

(24)
$$B^k_t = \sum_t W^k_{gt} B^k_{gt} .$$

Notice that (1) the A^{k+1}_{gi} and B^{k+1}_{gt} are, <u>for each group g</u>, related to the A^k_{gi} and B^k_t by the same formula as in the one-group case, except that one uses the same B^k_t in each group. Each new approximation B^{k+1}_t is then calculated as a weighted average of the B^k_{gt}. (The numbers B^k_{gt}, given by (2.23), are of course only auxiliary quantities, and are not to be confused with successive approximations to the MLE's B^*_{gt} under the alternative hypothesis.

To test the null hypothesis, let ℓ^*_0 denote the maximum of the log-likelihood function under the null hypothesis. Then, in large samples, the statistic $2(\sum_g \ell^*_g - \ell^*_0)$ will have approximately a chi-squared distribution with $(G - 1)(T - 1)$ degrees of freedom.

Exploiting the symmetry between the age and date effects, one can easily modify the preceding analysis to test for differences in age effects among the groups.

Normalization and Comparison of Age and Date Effects from Different Groups

Suppose it has been decided that differences in age and date effects among different groups are statistically significant. To further study these differences one must keep in mind that the age and date effects in each group are identified only up to multiplication of the age effects by a (positive) constant and division of the date effects by the same constant. As this constant increased, the age effects would move out along a ray in $(I - 1)$-dimensional space, while the date effects would move correspondingly in along a ray in $(T - 1)$-dimensional space. The following discussion deals explicitly with the comparison of date effects. The implications for the comparison of age effects will be obvious.

In the absence of any further information to compensate for the lack of identification, one can only say that two vectors of date effects are "similar" if they are close to being proportional. In particular, we could say that there is an absence of date effects if they were all equal. In the latter case, a natural normalization would be to set all the date effects equal to 1. More generally, it would seem natural to normalize the date effects by requiring that, for some homogeneous function f, $f(B) = 1$, where B denotes the vector (B_t); the function f would have the further property that $f(1,\ldots,1) = 1$.

Unfortunately, we can find no compelling reason to choose one such function f over another. In subsequent sections we use the geometric mean

$$f(B) = \prod_t B_t^{w_t} ,$$

where the weights w_t are defined by

$$w_t \equiv \frac{P_{..t}}{P_{...}} = \frac{\sum_{gi} P_{git}}{\sum_{gi} P_{gi}} .$$

The iterative algorithm for calculating MLE's described above does not preserve this harmonic mean from one iteration to another. Therefore, before comparing date (and age) effects from different groups, one should, in each group g, divide the date effects B^*_{gt} resulting from the algorithm by the quantity

$$\prod_t (B^*_{gt})^{w_t} ,$$

and multiply each age effect (in that group) by the same quantity.

Appendix 2. Complete Tabulation of Results

COHORT SAMPLE SIZES
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

DATE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1925	1			
1926		2		
1927		2		
1928	5	3		
1929	2	1		
1930	4	4		2
1931	15	6	2	3
1932	14	10	2	3
1933	19	13	1	7
1934	34	12	3	5
1935	49	19	3	10
1936	67	21	3	12
1937	55	26	3	11
1938	75	18	3	17
1939	84	34	9	19
1940	96	37	7	21
1941	106	45	2	20
1942	132	50	14	27
1943	158	52	6	29
1944	90	44	3	16
1945	68	28	4	19
1946	62	30	12	12
1947	100	27	5	26
1948	150	62	14	32
1949	214	72	22	43
1950	253	90	16	38
1951	305	111	34	66
1952	320	128	34	80
1953	374	140	55	79
1954	375	107	49	78
1955	404	145	48	84
1956	411	130	53	83
1957	383	139	60	85
1958	382	139	60	73
1959	414	154	54	75
1960	402	133	39	101
1961	487	170	70	102
1962	490	189	65	107
1963	594	171	72	110
1964	684	230	91	132
1965	739	200	101	126
1966	754	232	111	125
1967	823	262	111	154
1968	867	261	130	168
1969	885	290	139	183
1970	848	260	158	189
1971	670	225	141	205
1972	506	134	79	168
1973	285	90	72	113
TOTAL	14255	4748	1960	3058

RAW AGE-RELATED PROMOTION RATES
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

AGE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1	0.022	0.014	0.039	0.028
2	0.045	0.021	0.067	0.036
3	0.101	0.052	0.131	0.057
4	0.138	0.086	0.170	0.114
5	0.179	0.126	0.165	0.144
6	0.202	0.151	0.195	0.169
7	0.228	0.189	0.156	0.173
8	0.208	0.170	0.166	0.183
9	0.177	0.162	0.160	0.141
10	0.181	0.184	0.147	0.139
11	0.166	0.193	0.184	0.165
12	0.180	0.160	0.148	0.191
13	0.177	0.174	0.137	0.155
14	0.203	0.187	0.122	0.148
15	0.169	0.154	0.181	0.139
16	0.187	0.166	0.270	0.103
17	0.151	0.136	0.158	0.127
18	0.167	0.167	0.108	0.133
19	0.127	0.172	0.065	0.098
20	0.155	0.128	0.121	0.107
21	0.137	0.190	0.105	0.140
22	0.121	0.109	0.098	0.194
23	0.129	0.106	0.220	0.085
24	0.158	0.209	0.212	0.037
25	0.171	0.086	0.143	0.225
26	0.120	0.185	0.083	0.059
27	0.200	0.231	0.045	0.185
28	0.221	0.106	0.111	0.227
29	0.198	0.250	0.286	0.050
30	0.090	0.091	0.077	
31	0.175	0.143	0.444	
32	0.176	0.043		0.143
33	0.163	0.050	0.333	0.750
34	0.081	0.143	0.333	
35	0.333		0.500	0.167
36	0.143	0.083		
37	0.059	0.100	1.000	1.000
38	0.071			
39	0.200	0.125	20.000	
40	0.167			
41	0.333			
42		0.200		
43				

RAW DATE-RELATED PROMOTION RATES
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

DATE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1925				
1926				
1927				
1928				
1929				
1930				
1931		0.059		
1932				
1933				0.071
1934	0.011	0.020		0.056
1935	0.036			0.077
1936	0.010		0.077	
1937	0.008		0.067	
1938	0.028	0.023	0.125	
1939	0.028	0.006		
1940	0.029	0.041		0.060
1941	0.023	0.004	0.030	
1942	0.020		0.022	
1943	0.021	0.030		0.029
1944	0.014	0.016	0.019	0.011
1945	0.042	0.034		0.036
1946	0.072	0.043	0.014	0.072
1947	0.071	0.068	0.028	0.042
1948	0.085	0.073	0.012	0.104
1949	0.060	0.042	0.081	0.056
1950	0.069	0.060	0.045	0.075
1951	0.076	0.049	0.043	0.050
1952	0.079	0.054	0.030	0.079
1953	0.066	0.051	0.033	0.057
1954	0.075	0.063	0.027	0.064
1955	0.067	0.055	0.027	0.055
1956	0.079	0.064	0.045	0.065
1957	0.077	0.063	0.051	0.068
1958	0.083	0.056	0.058	0.075
1959	0.083	0.075	0.038	0.080
1960	0.092	0.088	0.077	0.104
1961	0.087	0.081	0.067	0.073
1962	0.093	0.097	0.078	0.089
1963	0.107	0.100	0.071	0.098
1964	0.110	0.105	0.106	0.082
1965	0.121	0.123	0.113	0.132
1966	0.141	0.118	0.135	0.112
1967	0.162	0.135	0.132	0.165
1968	0.185	0.189	0.216	0.188
1969	0.220	0.182	0.263	0.134
1970	0.234	0.163	0.286	0.156
1971	0.222	0.145	0.234	0.129
1972	0.245	0.167	0.314	0.167

LOGIT AGE EFFECTS
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

AGE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1	0.013	0.012	0.028	0.026
2	0.037	0.017	0.047	0.033
3	0.082	0.044	0.035	0.053
4	0.114	0.073	0.130	0.106
5	0.154	0.103	0.135	0.137
6	0.182	0.136	0.163	0.163
7	0.216	0.177	0.148	0.172
8	0.203	0.162	0.154	0.184
9	0.173	0.156	0.152	0.141
10	0.178	0.182	0.142	0.138
11	0.161	0.130	0.173	0.161
12	0.169	0.155	0.137	0.184
13	0.162	0.164	0.124	0.149
14	0.181	0.172	0.099	0.140
15	0.149	0.143	0.147	0.125
16	0.166	0.153	0.213	0.093
17	0.134	0.123	0.129	0.115
18	0.149	0.152	0.088	0.117
19	0.114	0.160	0.049	0.085
20	0.140	0.117	0.095	0.093
21	0.124	0.176	0.087	0.122
22	0.112	0.100	0.080	0.173
23	0.121	0.100	0.173	0.073
24	0.148	0.183	0.166	0.031
25	0.156	0.070	0.110	0.131
26	0.103	0.145	0.070	0.049
27	0.162	0.175	0.038	0.161
28	0.175	0.075	0.037	0.184
29	0.153	0.179	0.232	0.043
30	0.066	0.067	0.048	
31	0.123	0.101	0.252	
32	0.122	0.031		0.109
33	0.102	0.035	0.191	0.495
34	0.050	0.105	0.152	
35	0.134		0.243	0.101
36	0.076	0.061		
37	0.031	0.058	0.548	0.720
38	0.037			
39	0.102	0.062	0.513	
40	0.092		0.333	1.000
41	0.134		0.333	1.000
42		0.103	0.333	1.000
43			0.333	1.000

LOGIT DATE EFFECTS
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

DATE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1925		1.000	1.001	1.000
1926			1.001	1.000
1927			1.001	1.000
1928			1.001	1.000
1929			1.001	1.000
1930			1.001	
1931		1.230		
1932				
1933				1.685
1934	0.158	0.367		1.002
1935	0.542			1.349
1936	0.144		0.885	
1937	0.087		0.724	
1938	0.319	0.237	1.288	
1939	0.238	0.076		
1940	0.295	0.510		0.711
1941	0.218	0.050	0.285	
1942	0.191		0.226	
1943	0.192	0.349		0.300
1944	0.122	0.177	0.153	0.102
1945	0.322	0.333		0.315
1946	0.517	0.389	0.123	0.533
1947	0.501	0.587	0.229	0.358
1948	0.638	0.647	0.104	0.321
1949	0.488	0.390	0.734	0.523
1950	0.619	0.603	0.439	0.735
1951	0.733	0.533	0.454	0.534
1952	0.784	0.624	0.321	0.888
1953	0.658	0.608	0.358	0.650
1954	0.726	0.736	0.285	0.703
1955	0.634	0.628	0.274	0.590
1956	0.725	0.705	0.436	0.669
1957	0.680	0.665	0.488	0.679
1958	0.706	0.577	0.547	0.718
1959	0.695	0.764	0.342	0.741
1960	0.757	0.885	0.678	0.979
1961	0.721	0.805	0.581	0.703
1962	0.777	0.981	0.696	0.855
1963	0.926	1.027	0.639	0.956
1964	0.989	1.130	0.977	0.806
1965	1.116	1.335	1.081	1.321
1966	1.331	1.313	1.335	1.123
1967	1.561	1.553	1.299	1.712
1968	1.826	2.234	2.179	2.025
1969	2.239	2.332	2.780	1.483
1970	2.421	2.140	3.208	1.759
1971	2.240	1.868	2.642	1.483
1972	2.343	1.979	3.317	1.870

MEDIAN AGES TO TENURE
BY TYPE OF INSTITUTION AND CONTROL, 1973 SURVEY

DATE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC 4-YR. COLLEGES	PRIVATE 4-YR. COLLEGES
1925		7.946	6.907	7.273
1926			6.907	7.273
1927			6.907	7.273
1928			6.907	7.273
1929			6.907	7.273
1930			6.907	
1931		7.186		
1932				
1933				5.599
1934	14.641	12.036		7.265
1935	9.232			6.226
1936	14.950		7.516	
1937	15.875		8.654	
1938	11.896	12.825	5.871	
1939	12.223	15.913		
1940	12.265	10.668		9.004
1941	13.523	16.380	19.367	
1942	13.972		23.644	
1943	13.955	12.231		16.648
1944	15.378	14.342	30.922	28.250
1945	11.856	12.419		16.034
1946	9.459	11.796	36.146	10.288
1947	9.613	10.123	23.491	14.418
1948	8.437	9.742	36.980	7.604
1949	9.740	11.788	8.092	11.077
1950	8.584	10.016	12.859	8.737
1951	7.809	10.498	12.451	11.011
1952	7.557	9.883	16.466	7.749
1953	8.284	9.979	15.342	9.642
1954	7.849	8.906	19.387	9.086
1955	8.468	9.859	20.227	10.318
1956	7.852	9.402	12.942	9.433
1957	8.12[illegible]	9.632	11.661	9.333
1958	7.3[illegible]	10.193	10.654	8.940
1959	8.[illegible]15	9.078	15.728	8.746
1960	7.689	8.458	9.084	7.357
1961	7.872	8.859	10.237	9.087
1962	7.591	8.016	8.901	7.909
1963	6.941	7.852	9.532	7.454
1964	6.742	7.510	7.012	8.220
1965	6.386	6.941	6.568	6.294
1966	5.881	6.985	5.763	6.839
1967	5.466	6.546	5.846	5.558
1968	5.072	5.596	4.422	5.141
1969	4.633	5.559	3.872	5.332
1970	4.478	5.755	3.624	5.490
1971	4.633	6.081	3.364	5.932
1972	4.543	5.940	3.569	5.337
MED	6.709	7.946	6.909	7.273
IQR	6.533	7.139	7.797	7.324
RATIO	0.975	0.898	1.129	1.007

COHORT SAMPLE SIZES
FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927						
1928			1			
1929					1	
1930					2	
1931	1		1	2	3	
1932		1		3	1	1
1933		1		4	2	1
1934	5		2	4	2	1
1935	5	1	6	9	5	5
1936	3	3	3	11	3	2
1937	1	1	6	7	9	1
1938	7		15	10	5	3
1939	12	1	8	18	10	1
1940	4	5	9	15	13	6
1941	12	3	14	11	13	4
1942	9	10	10	13	18	5
1943	16	8	17	24	12	4
1944	12	6	8	12	7	8
1945	7	5	4	12	5	2
1946	4	2	6	14	7	3
1947	5	4	17	12	12	10
1948	15	9	9	23	18	10
1949	21	12	17	23	23	16
1950	17	13	32	39	32	14
1951	25	12	28	40	53	15
1952	15	21	25	47	42	16
1953	25	16	29	44	59	15
1954	23	16	44	42	56	13
1955	23	18	36	31	58	16
1956	26	25	41	55	47	18
1957	21	23	33	40	51	16
1958	24	21	35	40	48	13
1959	27	29	42	42	58	23
1960	21	24	33	39	61	21
1961	28	27	49	62	57	24
1962	35	30	50	77	66	24
1963	56	47	53	66	70	25
1964	40	50	62	86	105	34
1965	55	68	71	89	92	34
1966	43	78	63	83	109	31
1967	35	73	75	99	113	52
1968	40	56	92	72	125	70
1969	51	68	89	52	121	59
1970	28	51	88	53	128	62
1971	16	32	83	27	113	58
1972	8	15	71	7	95	41
1975	5	14	43	7	54	14
TOTAL	826	905	1420	1466	1990	791

RAW AGE-RELATED PROMOTION RATES FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

AGE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1	0.016	0.022	0.030	0.007	0.022	0.024
2	0.024	0.075	0.040	0.015	0.048	0.059
3	0.052	0.133	0.095	0.052	0.105	0.148
4	0.073	0.182	0.160	0.080	0.166	0.231
5	0.179	0.254	0.163	0.141	0.198	0.192
6	0.224	0.247	0.168	0.232	0.198	0.201
7	0.207	0.181	0.230	0.296	0.221	0.174
8	0.268	0.189	0.247	0.235	0.130	0.133
9	0.225	0.161	0.142	0.213	0.168	0.187
10	0.229	0.156	0.148	0.208	0.181	0.159
11	0.213	0.073	0.209	0.170	0.141	0.155
12	0.232	0.125	0.153	0.219	0.199	0.119
13	0.212	0.221	0.189	0.139	0.153	0.139
14	0.274	0.188	0.194	0.296	0.232	0.228
15	0.170	0.235	0.163	0.162	0.123	0.098
16	0.133	0.263	0.144	0.293	0.124	0.163
17	0.125	0.233	0.127	0.090	0.202	0.077
18	0.212	0.250	0.203	0.158	0.165	0.088
19	0.222	0.200	0.143	0.170	0.110	0.133
20	0.080	0.429	0.122	0.278	0.145	0.160
21	0.136	0.083	0.200	0.029	0.148	0.042
22	0.050		0.176	0.061	0.244	0.143
23	0.118	0.571	0.133	0.192	0.081	0.050
24	0.231		0.200	0.130	0.059	0.200
25	0.444	0.167	0.042	0.278	0.269	0.182
26	0.500	0.200	0.045	0.059	0.083	0.100
27	0.250	0.250	0.222	0.133	0.143	
28	1.000	0.500	0.385	0.083	0.400	
29		1.000	0.182	0.091	0.273	
30				0.100	0.100	0.111
31			0.429	0.286		0.286
32			0.167	0.167	0.250	
33			0.500	0.200	0.167	0.250
34						
35			0.500	1.500	0.200	0.500
36	1.000			1.000		
37	20.000					
38						1.000
39				20.000		
40						20.000
41					20.000	
42						
43						

RAW DATE-RELATED PROMOTION RATES
FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927						
1928						
1929						
1930						
1931						
1932						
1933						
1934						
1935					0.231	
1936				0.031		
1937						
1938	0.048			0.065	0.034	
1939		0.333	0.050	0.016	0.054	
1940	0.028				0.018	0.050
1941	0.116			0.035		0.043
1942			0.028	0.010	0.012	
1943		0.067	0.011	0.017	0.021	0.067
1944	0.013		0.022	0.023	0.010	
1945	0.062	0.108	0.032	0.022	0.050	0.026
1946	0.076	0.083	0.075	0.094	0.069	0.105
1947	0.077	0.081	0.038	0.094	0.056	0.067
1948	0.107	0.070	0.106	0.095	0.050	0.146
1949	0.061	0.122	0.025	0.056	0.076	0.032
1950	0.084	0.051	0.064	0.042	0.072	0.041
1951	0.082	0.060	0.070	0.069	0.079	0.073
1952	0.105	0.100	0.083	0.091	0.069	0.077
1953	0.057	0.032	0.065	0.079	0.041	0.039
1954	0.079	0.058	0.065	0.116	0.081	0.065
1955	0.042	0.061	0.041	0.055	0.060	0.097
1956	0.054	0.086	0.040	0.082	0.067	0.048
1957	0.090	0.113	0.055	0.085	0.079	0.102
1958	0.140	0.066	0.076	0.082	0.065	0.093
1959	0.092	0.097	0.049	0.100	0.057	0.101
1960	0.085	0.099	0.068	0.137	0.071	0.104
1961	0.076	0.064	0.072	0.098	0.070	0.070
1962	0.113	0.107	0.088	0.096	0.082	0.071
1963	0.086	0.100	0.086	0.121	0.122	0.084
1964	0.093	0.067	0.109	0.109	0.111	0.098
1965	0.125	0.114	0.150	0.112	0.128	0.107
1966	0.133	0.143	0.178	0.100	0.143	0.150
1967	0.143	0.145	0.194	0.150	0.182	0.152
1968	0.185	0.208	0.174	0.159	0.152	0.185
1969	0.207	0.287	0.254	0.193	0.234	0.185
1970	0.236	0.236	0.277	0.239	0.246	0.259
1971	0.265	0.286	0.223	0.197	0.261	0.247
1972	0.325	0.181	0.309	0.217	0.267	0.202

LOGIT AGE EFFECTS
FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

AGE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1	0.016	0.020	0.021	0.007	0.017	0.019
2	0.023	0.067	0.029	0.013	0.037	0.047
3	0.045	0.115	0.068	0.045	0.081	0.123
4	0.061	0.157	0.123	0.067	0.135	0.205
5	0.158	0.228	0.131	0.120	0.172	0.182
6	0.204	0.228	0.154	0.206	0.179	0.202
7	0.189	0.178	0.230	0.275	0.214	0.184
8	0.240	0.186	0.252	0.225	0.191	0.142
9	0.215	0.175	0.138	0.203	0.170	0.190
10	0.219	0.166	0.149	0.208	0.179	0.171
11	0.201	0.077	0.204	0.171	0.138	0.154
12	0.226	0.125	0.139	0.212	0.192	0.121
13	0.212	0.221	0.176	0.134	0.138	0.140
14	0.282	0.171	0.169	0.278	0.212	0.224
15	0.179	0.214	0.142	0.146	0.107	0.103
16	0.148	0.272	0.125	0.272	0.104	0.168
17	0.135	0.224	0.110	0.088	0.168	0.076
18	0.239	0.225	0.182	0.143	0.135	0.081
19	0.228	0.183	0.131	0.164	0.096	0.123
20	0.083	0.375	0.115	0.253	0.125	0.145
21	0.136	0.072	0.200	0.028	0.125	0.039
22	0.047		0.159	0.056	0.241	0.143
23	0.111	0.481	0.119	0.172	0.087	0.046
24	0.206		0.187	0.119	0.061	0.228
25	0.368	0.142	0.033	0.232	0.264	0.214
26	0.394	0.125	0.037	0.045	0.078	0.100
27	0.278	0.157	0.150	0.107	0.110	
28	1.131	0.293	0.247	0.072	0.306	
29		0.556	0.121	0.074	0.209	
30				0.077	0.074	0.073
31			0.266	0.200		0.204
32			0.102	0.125	0.165	
33			0.284	0.125	0.105	0.206
34		0.999				
35		0.999	0.392	0.911	0.096	0.336
36	0.544	0.999		0.594		
37	10.758	0.999				
38	0.998	0.999				0.577
39	0.998	0.999		12.427		
40	0.998	0.999		1.000		10.697
41	0.998	0.999		1.000	10.142	0.998
42	0.998	0.999		1.000	0.999	0.998
43	0.998	0.999		1.000	0.999	0.998

LOGIT DATE EFFECTS
FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925	1.002	1.001	1.003	1.000	1.001	1.002
1926	1.002	1.001	1.003	1.000	1.001	1.002
1927	1.002	1.001	1.003	1.000	1.001	1.002
1928	1.002	1.001		1.000	1.001	1.002
1929	1.002	1.001		1.000		1.002
1930	1.002	1.001		1.000		1.002
1931		1.001				1.002
1932						
1933						
1934						
1935					2.686	
1936				0.765		
1937						
1938	0.676			0.922	0.382	
1939		2.318	0.787	0.222	0.595	
1940	0.327				0.221	0.408
1941	1.557			0.361		0.347
1942			0.283	0.095	0.122	
1943		0.718	0.115	0.159	0.187	0.501
1944	0.131		0.177	0.197	0.077	
1945	0.560	0.825	0.235	0.164	0.348	0.193
1946	0.578	0.566	0.559	0.707	0.450	0.726
1947	0.507	0.500	0.285	0.692	0.387	0.520
1948	0.749	0.488	0.803	0.726	0.381	1.242
1949	0.490	0.993	0.203	0.445	0.625	0.31[illegible]
1950	0.733	0.469	0.576	0.367	0.655	0.379
1951	0.764	0.505	0.697	0.693	0.847	0.652
1952	0.949	0.893	0.838	0.980	0.731	0.669
1953	0.527	0.274	0.627	0.857	0.428	0.311
1954	0.741	0.454	0.654	1.244	0.814	0.493
1955	0.373	0.452	0.397	0.548	0.578	0.734
1956	0.470	0.640	0.377	0.768	0.593	0.370
1957	0.779	0.866	0.482	0.772	0.661	0.796
1958	1.167	0.488	0.655	0.690	0.524	0.702
1959	0.772	0.734	0.413	0.840	0.464	0.786
1960	0.690	0.737	0.547	1.199	0.571	0.854
1961	0.580	0.463	0.600	0.963	0.553	0.576
1962	0.962	0.773	0.738	0.911	0.664	0.577
1963	0.811	0.803	0.734	1.260	1.009	0.670
1964	0.895	0.532	0.965	1.197	0.966	0.802
1965	1.268	0.953	1.406	1.255	1.169	0.888
1966	1.370	1.296	1.715	1.093	1.349	1.221
1967	1.382	1.269	1.972	1.633	1.758	1.364
1968	1.726	1.700	1.838	1.745	1.500	1.303
1969	1.936	2.350	2.85[illegible]	1.937	2.357	1.896
1970	2.177	1.878	3.294	2.288	2.574	2.585
1971	2.457	2.106	2.569	1.737	2.726	2.324
1972	2.812	1.251	3.728	1.623	2.731	1.733

MEDIAN AGES TO TENURE
FOR PUBLIC UNIVERSITY FIELDS, 1973 SURVEY

DATE	*BIOLOGICAL SCIENCES*	*ENGINEERING*	*HUMANITIES*	*PHYSICAL SCIENCES*	*SOCIAL SCIENCES*	*EDUCATION*
1925	7.229	5.733	6.908	7.108	6.591	5.869
1926	7.229	5.733	6.908	7.108	6.591	5.869
1927	7.229	5.733	6.908	7.108	6.591	5.869
1928	7.229	5.733		7.108	6.591	5.869
1929	7.229	5.733		7.108		5.869
1930	7.229	5.733		7.108		5.869
1931		5.733				5.869
1932						
1933						
1934						
1935					4.141	
1936				8.071		
1937						
1938	8.717			7.386	12.836	
1939		3.873	7.619	19.299	9.098	
1940	13.580				20.560	11.322
1941	5.937			13.298		13.579
1942			12.432	35.119	28.789	
1943		7.174	15.437	26.327	22.879	3.824
1944	26.614		14.102	22.337	40.091	
1945	9.703	6.490	13.140	26.101	13.641	24.645
1946	3.520	8.610	3.226	8.448	11.303	7.363
1947	10.315	3.539	12.413	8.551	12.683	3.535
1948	8.247	3.740	7.560	8.319	12.867	5.137
1949	10.544	5.756	13.641	11.381	8.736	14.753
1950	8.347	10.162	3.051	13.200	8.507	12.787
1951	8.157	9.470	7.980	8.545	7.137	8.084
1952	7.401	6.118	7.435	7.176	7.875	7.918
1953	10.049	15.685	8.576	7.640	11.695	15.027
1954	8.293	10.764	8.331	6.593	7.379	9.946
1955	12.575	10.862	10.813	9.820	9.294	7.289
1956	10.838	7.807	11.015	8.051	9.125	13.066
1957	8.067	6.259	10.028	8.026	8.452	6.831
1958	6.752	9.742	8.317	8.568	9.955	7.588
1959	8.110	7.058	10.654	7.713	11.077	6.885
1960	8.623	7.035	9.347	6.676	9.372	6.518
1961	9.506	10.427	8.827	7.617	9.588	8.816
1962	7.358	6.800	7.812	7.427	8.423	8.808
1963	7.314	6.619	7.827	6.573	6.568	7.910
1964	7.589	9.045	7.011	6.679	6.708	6.795
1965	6.503	5.881	6.035	6.581	6.038	6.348
1966	6.277	5.000	5.485	6.874	5.677	5.127
1967	6.252	5.058	5.112	6.052	4.965	4.327
1968	5.733	4.452	5.298	5.927	5.383	4.115
1969	5.515	3.849	4.284	5.746	4.385	4.130
1970	5.301	4.263	3.989	5.471	4.220	3.648
1971	5.083	4.046	4.504	5.935	4.114	3.790
1972	4.866	5.098	3.805	6.063	4.110	4.339
MED	7.234	5.737	6.315	7.108	6.596	5.874
IQR	5.737	6.256	6.561	5.614	6.689	6.659
RATIO	0.793	1.091	0.949	0.790	1.014	1.134

COHORT SAMPLE SIZES
FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927				1	1	
1928					1	
1929			2			
1930						
1931			2			
1932	1			2		
1933	3		1	3	3	
1934				2	3	
1935	1		3	2	3	
1936	3		2	6	1	
1937	1	1	1	3		1
1938			3	4	4	
1939			6	1	3	1
1940		1	6	2	4	2
1941		1	5	11	5	
1942	1	2	5	10	5	1
1943	3	2	5	4	7	3
1944	3	4	7	5	7	1
1945	2		5	12	12	2
1946			6	2	8	2
1947		1	3	2	8	2
1948	1	1	4	4		1
1949	1	2	13	7	13	2
1950	1	3	4	14	15	7
1951	4	11	7	16	18	3
1952	6	9	15	16	15	6
1953	4	8	10	23	19	3
1954	7	12	20	18	25	11
1955	6	6	11	10	19	8
1956	7	6	15	24	22	7
1957	10	7	12	12	19	4
1958	6	10	17	17	24	6
1959	10	6	14	21	14	3
1960	13	11	17	22	23	9
1961	9	6	15	24	23	1
1962	3	14	30	21	27	2
1963	11	11	26	33	31	4
1964	13	15	15	24	24	4
1965	10	27	22	33	38	15
1966	11	10	20	19	39	8
1967	7	27	25	28	32	8
1968	12	16	30	37	39	10
1969	15	13	28	28	45	10
1970	7	15	34	39	58	13
1971	5	16	25	26	60	10
1972	5	18	31	17	57	7
1975	1	5	20	6	32	5
	2	2	16	2	19	2
TOTAL	207	239	558	613	825	196

RAW AGE-RELATED PROMOTION RATES
FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

AGE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1	0.005	0.010	0.021	0.005	0.013	0.032
2		0.021	0.018	0.019	0.024	0.022
3		0.064	0.068	0.036	0.060	0.030
4	0.021	0.147	0.079	0.058	0.119	0.137
5	0.064	0.136	0.157	0.122	0.147	0.103
6	0.067	0.252	0.188	0.143	0.163	0.172
7	0.094	0.263	0.235	0.200	0.198	0.194
8	0.118	0.173	0.178	0.236	0.188	0.232
9	0.143	0.233	0.173	0.231	0.098	0.170
10	0.160	0.229	0.206	0.200	0.192	0.125
11	0.167	0.154	0.265	0.248	0.149	0.444
12	0.227	0.258	0.107	0.241	0.140	0.083
13	0.162	0.071	0.298	0.145	0.144	0.143
14	0.125	0.273	0.140	0.259	0.135	0.050
15	0.167	0.615	0.064	0.152	0.117	0.250
16	0.211	0.300	0.179	0.179	0.190	0.231
17	0.059	0.250	0.026	0.219	0.154	0.182
18	0.077	0.600	0.226	0.280	0.209	0.250
19	0.182		0.476	0.200	0.105	0.333
20	0.222		0.313	0.176	0.194	0.200
21	0.286	3.000	0.231	0.143	0.192	
22			0.083	0.077	0.182	0.250
23			0.200	0.083		1.000
24			0.250	0.091	0.105	1.000
25	0.250			0.222		
26	0.333	20.000	0.333		0.214	
27			0.200	0.333	0.400	
28				0.500	0.250	
29			0.667	0.333	0.333	
30						
31	0.500			0.500	0.200	20.000
32						
33	1.000					
34					0.333	
35						
36					0.500	
37			20.000			
38						
39	20.000					
40						
41						
42				1.000		
43						

RAW DATE-RELATED PROMOTION RATES FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927						
1928						
1929						
1930						
1931					1.000	
1932						
1933						
1934			0.143			
1935						
1936						
1937						
1938						
1939					0.048	
1940			0.034	0.121		
1941			0.030			
1942						
1943			0.023	0.061	0.023	
1944				0.052	0.018	0.100
1945				0.034	0.033	0.091
1946		0.200	0.055	0.071		
1947		0.100	0.093	0.111	0.062	0.077
1948	0.158	0.091	0.063	0.173	0.040	0.071
1949			0.038	0.031	0.011	0.050
1950	0.043	0.042	0.046	0.039	0.103	0.045
1951	0.036	0.031	0.053	0.134	0.028	0.037
1952	0.032	0.053	0.075	0.029	0.067	0.023
1953	0.056	0.087	0.111	0.053	0.028	0.045
1954	0.050	0.061	0.063	0.117	0.067	0.020
1955	0.044	0.038	0.038	0.055	0.030	0.036
1956	0.038	0.071	0.063	0.077	0.075	0.053
1957	0.017	0.119	0.103	0.043	0.082	0.068
1958	0.015	0.048	0.083	0.066	0.077	0.088
1959	0.039	0.074	0.105	0.081	0.068	0.119
1960	0.062	0.104	0.061	0.101	0.097	0.071
1961	0.105	0.038	0.045	0.086	0.067	0.160
1962	0.061	0.127	0.053	0.107	0.096	0.256
1963	0.080	0.080	0.107	0.122	0.105	0.237
1964	0.101	0.075	0.098	0.116	0.066	0.178
1965	0.042	0.160	0.191	0.113	0.106	0.082
1966	0.051	0.155	0.161	0.088	0.130	0.056
1967	0.068	0.156	0.186	0.120	0.168	0.208
1968	0.157	0.162	0.252	0.184	0.194	0.167
1969	0.135	0.290	0.250	0.151	0.210	0.123
1970	0.135	0.267	0.245	0.178	0.130	0.210
1971	0.080	0.182	0.183	0.117	0.181	0.150
1972	0.128	0.134	0.140	0.217	0.203	0.182

LOGIT AGE EFFECTS
FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

AGE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1	0.005	0.009	0.016	0.005	0.010	0.027
2		0.019	0.014	0.018	0.018	0.019
3		0.057	0.054	0.034	0.047	0.026
4	0.021	0.123	0.065	0.052	0.098	0.114
5	0.061	0.119	0.135	0.113	0.127	0.091
6	0.060	0.232	0.177	0.137	0.154	0.156
7	0.089	0.252	0.237	0.199	0.195	0.177
8	0.120	0.173	0.182	0.227	0.190	0.246
9	0.137	0.242	0.170	0.231	0.096	0.156
10	0.146	0.220	0.223	0.214	0.203	0.114
11	0.155	0.134	0.314	0.243	0.155	0.391
12	0.217	0.248	0.115	0.240	0.144	0.073
13	0.157	0.060	0.298	0.140	0.146	0.131
14	0.138	0.248	0.153	0.249	0.186	0.033
15	0.230	0.543	0.066	0.149	0.104	0.167
16	0.289	0.279	0.167	0.167	0.174	0.176
17	0.065	0.212	0.023	0.217	0.130	0.151
18	0.068	0.482	0.191	0.261	0.182	0.311
19	0.135		0.495	0.188	0.093	0.272
20	0.215		0.395	0.153	0.163	0.182
21	0.383	3.483	0.292	0.125	0.172	
22			0.079	0.076	0.160	0.181
23			0.175	0.084		1.066
24			0.189	0.088	0.075	0.671
25	0.277			0.183		
26	0.513	15.125	0.223		0.134	
27			0.127	0.316	0.274	
28				0.427	0.178	
29			0.303	0.259	0.279	
30						
31	0.511			0.455	0.178	10.473
32						
33	0.605					
34					0.323	
35						
36					0.375	
37			10.310			
38						
39	11.839					
40						
41						
42				0.656		
43						

LOGIT DATE EFFECTS
FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927						
1928						
1929						
1930						
1931					6.786	
1932						
1933						
1934	1.002		1.482			
1935						
1936						
1937						
1938						
1939					0.488	
1940			0.360	1.360		
1941			0.359			
1942						
1943			0.214	0.593	0.243	
1944				0.545	0.202	1.282
1945				0.312	0.355	0.375
1946		1.404	0.431	0.563		
1947		0.635	0.657	0.853	0.535	0.887
1948	1.523	0.656	0.472	1.306	0.362	0.667
1949			0.730	0.271	0.106	0.582
1950	0.441	0.491	0.348	0.371	1.108	0.592
1951	0.379	0.462	0.460	1.513	0.288	0.532
1952	0.433	0.692	0.655	0.360	0.728	0.341
1953	1.013	1.012	1.125	0.636	0.305	0.595
1954	1.032	0.690	0.604	1.292	0.714	0.243
1955	0.829	0.369	0.348	0.628	0.303	0.334
1956	0.576	0.518	0.584	0.790	0.756	0.479
1957	0.257	0.936	0.871	0.391	0.810	0.620
1958	0.253	0.366	0.757	0.604	0.703	0.675
1959	0.800	0.491	0.931	0.714	0.535	0.867
1960	1.120	0.822	0.490	0.933	0.901	0.508
1961	1.697	0.318	0.396	0.761	0.625	1.154
1962	0.827	1.115	0.476	1.085	0.946	1.335
1963	1.168	0.616	0.934	1.258	1.044	1.918
1964	1.516	0.599	0.911	1.279	0.688	1.796
1965	0.655	1.569	1.653	1.240	1.109	0.995
1966	0.748	1.509	1.444	0.856	1.386	0.626
1967	0.353	1.370	1.883	1.240	1.821	2.357
1968	2.522	1.589	2.884	1.955	2.274	2.072
1969	1.984	2.628	3.141	1.701	2.721	1.769
1970	1.678	2.468	3.211	2.048	1.747	2.867
1971	0.985	1.965	2.501	1.291	2.602	1.750
1972	1.632	1.175	1.690	2.019	2.702	1.965

MEDIAN AGES TO TENURE
FOR PRIVATE UNIVERSITY FIELDS, 1973 SURVEY

DATE	BIOLOGICAL SCIENCES	ENGINEERING	HUMANITIES	PHYSICAL SCIENCES	SOCIAL SCIENCES	EDUCATION
1925						
1926						
1927						
1928						
1929						
1930						
1931					3.522	
1932						
1933						
1934	10.593		6.235			
1935						
1936						
1937						
1938						
1939					10.750	
1940			12.620	6.984		
1941			12.633			
1942						
1943			18.427	9.700	13.804	
1944				10.049	14.589	6.860
1945				12.399	12.358	7.637
1946		5.941	11.261	9.915		
1947		8.702	9.231	8.327	10.295	7.913
1948	8.961	8.558	10.708	7.091	12.260	9.625
1949			8.706	13.164	16.256	10.288
1950	15.123	10.122	12.859	11.574	7.088	10.236
1951	15.895	10.744	10.815	6.739	13.249	10.569
1952	15.218	8.336	9.247	11.694	9.056	15.268
1953	10.521	6.754	6.882	9.411	13.046	10.219
1954	10.463	8.345	9.639	7.120	9.128	17.861
1955	11.392	13.024	12.805	9.459	13.071	13.717
1956	13.466	9.757	9.797	8.588	8.823	10.306
1957	20.392	6.963	7.831	11.366	8.329	10.094
1958	20.475	13.084	8.511	9.621	9.192	9.530
1959	11.532	10.127	7.557	8.937	9.823	7.982
1960	10.105	7.546	10.550	8.023	7.792	10.720
1961	8.632	14.061	12.122	8.716	9.641	7.161
1962	11.401	6.502	10.670	7.595	7.624	5.699
1963	3.933	8.833	7.544	7.192	7.288	5.787
1964	8.375	8.959	7.646	7.147	9.273	5.336
1965	12.537	5.728	5.389	7.231	7.085	7.579
1966	11.799	5.802	6.295	8.315	6.470	10.064
1967	10.817	5.989	5.714	7.231	5.779	5.340
1968	7.566	5.704	4.895	6.181	5.271	5.616
1969	8.175	4.764	4.757	6.480	4.893	5.971
1970	8.666	4.898	4.722	6.083	5.878	4.917
1971	10.669	5.320	5.154	7.121	4.976	5.996
1972	8.749	6.369	5.941	6.113	4.906	5.733
MED	10.603	6.785	7.274	7.822	7.436	7.565
IQR	7.276	5.746	5.702	5.605	7.367	5.986
RATIO	0.686	0.847	0.784	0.717	0.991	0.791